

Brandon Ammonia Study No. 4

Ambient Air Ammonia Monitoring
by the Mobile Monitoring Unit

by
Special Studies Program

Air Standards and Studies Section
Environmental Management Services Branch
Environmental Management Division

Air Standards and Studies
Report No. 83-6

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Abstract

As part of a continuing monitoring program for ammonia in air in the Brandon area, the Mobile Monitoring Unit was utilized during July 11-15, 1983, to monitor ambient ammonia levels in the vicinity of Simplot Chemical Company Ltd. and the surrounding areas.

Results from this study indicate that elevated ammonia levels persist within the Simplot plume, and, under some conditions, this plume could cause the Manitoba Ambient Air Quality Guidelines to be exceeded within the residential areas surrounding the Brandon Industrial Park.

Introduction

As part of a continuing program for monitoring ammonia in ambient air in the Brandon area, and at the request of the Air Pollution Control Section of Environmental Control Services, a fourth study was undertaken by the Mobile Monitoring Unit to monitor ambient levels of ammonia in the vicinity of the Brandon Industrial Park. The objective of this study was to determine concentration levels of ammonia within the plume emitted from the Simplot chemicals operation, and to assess the impact of this plume on the air quality of the surrounding area. Three previous studies by the Mobile Monitoring Unit indicated that ammonia levels approaching or exceeding the Manitoba Air Quality Guideline were observed in areas affected by the plume from Simplot Chemical Company Ltd.

This study was performed during the period of July 11-15, 1983, with sampling being undertaken as conditions permitted, and as access to affected areas allowed. The following sections summarize background information, sampling and monitoring procedures used, and the results of this study.

Background

Simplot Chemical Company Ltd. has been operating a plant for the manufacture of nitrogenous agricultural fertilizer compounds since the mid-1960's. Routinely, the air pollutants from this type of

operation are both gaseous and particulate in nature. In Brandon, gaseous emissions from Simplot have included sulphur dioxide, oxides of nitrogen and ammonia. While ground level concentrations of ammonia attributable to emissions from the Simplot operation are not at a level which is considered to be normally injurious to health, they do represent a nuisance to the local population. The occurrence of several citizen complaints from the Brandon vicinity confirms this. Possible emission sources of ammonia include the low pressure ammonia storage tank, ammonium nitrate plant and urea plants.

On September 24, 1979 the Environmental Management Division established a stationary monitoring site to measure sulphur dioxide, oxides of nitrogen, and other pollutants. An additional monitoring system was installed on July 20, 1982 to monitor ambient ammonia levels. The station is located in the south east corner of the Assiniboine Community College parking lot approximately one kilometre north west of the Simplot plant. Monitoring at the site is continuous and on going. Data is processed monthly by the Impingement Program of Air Standards and Studies Section in the Environmental Management Division.

Procedures

Using meteorological data, and visual observation to determine direction of plume travel, a sampling site was picked adjacent to the company to be monitored. The Mobile Monitoring Unit (MMU) was set up in this position, and the sampling manifold was attached, allowing a sample to be obtained approximately three and one-half metres above ground level.

Analysis was achieved using a TGM555 automated colorimetric analyzer with ammonia module installed. Ammonia present in the air sample is converted to ammonium ion in the presence of a dilute solution of sulphuric acid (0.1N). The ammonium ion in solution reacts with sodium salicylate solution in the presence of sodium hypochlorite to produce an intense, emerald green colour, which is measured by the colorimeter. The results were compared to a calibration curve prepared prior to the survey to determine actual ammonia concentrations. This method is highly specific for ammonia, with few interferences.

A number of problems exist which are intrinsic to the mobile monitoring process itself. In some cases, access to areas affected by emissions from a plant is extremely limited, thus hampering monitoring operations, as representative samples cannot be obtained. Adverse meteorological conditions are also found to severely affect the sampling process. Automated, overnight sampling at one location is found to generate little meaningful data, unless the MMU is frequently checked, as wind conditions may vary over a long monitoring period. At these times during a survey data obtained are limited, and in most cases, represent background concentrations of the compound being analysed. Background levels are noted in the text of the discussion section.

Results were calculated on the basis of a one hour time-weighted average (TWA). The TWA in this study is defined as the observed sample concentrations averaged over a one hour sampling period.

Results

The results obtained from the sampling in the vicinity of Simplot Chemical Co. Ltd. are listed on pages 8-11 of this report, with a short summary of the findings at the end of the section. Hourly averages were calculated using twelve consecutive 5 minute average concentrations obtained by visually averaging the strip chart data obtained from the ammonia analyzer.

Wind speed and direction were obtained from an onboard meteorological tower, 10 metres in height, with a Windflo 540 wind speed and direction sensing instrument mounted at the apex. Wind speed and direction are recorded on strip charts as a voltage which must be converted to the appropriate units (km/hr or compass degrees). Directions are given relative to true north, with magnetic declination of approximately 11 degrees 51 minutes east in the vicinity of Brandon.

A downwind location was determined by comparing wind directions to the compass bearing of the source with respect to the monitoring site. This bearing, plus or minus 20° yields the wind direction range within which the receptor site is considered to be downwind of the source. However, this should be considered a generalization, as such factors as source-receptor distance, wind velocity and variability of the horizontal component of the wind will all influence the wind direction range. For this study, the following ranges are used:

- i) Site # 1 is downwind of the Simplot plant when the wind direction (hourly average) ranges between 230° to 270° (i.e. 250° $\pm$ 20°).
- ii) Site #2 is downwind of the Simplot plant when the wind direction ranges between 195° to 235°.
- iii) Site #3 is downwind of the Simplot plant when the wind direction ranges between 305° to 345°.
- iv) Site #4 is downwind of the Simplot plant when the wind direction ranges between 110° to 150°.
- v) Site #5 is downwind of the Simplot plant when the wind direction ranges between 115° to 155°.

By convention, the wind directions (in compass degrees) correspond to true wind directions as follows:

0° or 360° - North	180° - South
45° - North-east	225° - South-west
90° - East	270° - West
135° - South-east	315° - North

Table 1 Brandon Ammonia Study #4; Brandon Manitoba
July 11 - 15, 1983.

Time (hours)	Site No.	NH ₃ conc. (ppm) 1 hr. TWA Peak		Wind Dir.	Comments
July 11					
	1.				
1500 - 1600		<0.1	<0.1	265°	-Sunny, clear; small plume from Simplot operation; no detectable odors.
1600 - 1700		<0.1	<0.1	260°	
1700 - 1800		<0.1	<0.1	250°	
1800 - 1900		<0.1	<0.1	245°	
1900 - 2000		<0.1	<0.1	230°	
2000 - 2100		<0.1	<0.1	235°	
2100 - 2200		<0.1	<0.1	240°	
2200 - 2300		<0.1	0.35	250°	
2300 - 2400		<0.1	0.35	255°	
July 12					
0000 - 0100		<0.1	<0.1	240°	-Sunny, clear; plume emitted from Simplot, obscuring plant; visible haze; intermittent ammonia odor. -11:50AM - 12:30PM orange plume emitted from Simplot plant.
0100 - 0200		0.65	1.30	255°	
0200 - 0300		<0.1	<0.1	230°	
0300 - 0400		<0.1	<0.1	225°	
0400 - 0500		<0.1	<0.1	220°	
0500 - 0600		<0.1	<0.1	225°	
0600 - 0700		<0.1	<0.1	225°	
0700 - 0800		<0.1	<0.1	215°	
0800 - 0900		<0.1	<0.1	220°	
0900 - 0100	2.	<0.1	0.35	225°	
1000 - 1100		0.29	0.75	230°	
1100 - 1200		0.80	1.80	225°	
1200 - 1300		0.59	2.55	215°	
1300 - 1400		0.20	0.20	225°	
1400 - 1500	1.	<0.1	<0.1	215°	
1500 - 1600		<0.1	<0.1	200°	

Table 2 Brandon Ammonia Study #4; Brandon Manitoba
July 11 - 15, 1983.

Time (hours)	Site No.	NH ₃ conc. (ppm) 1 hr. TWA Peak		Wind Dr.	Comments
July 12					
	1.				
1600 - 1700		<0.10	<0.10	200°	
1700 - 1800		<0.10	<0.10	200°	
1800 - 1900		<0.10	0.40	Variable	
1900 - 2000		<0.10	<0.10	Variable	
2000 - 2100		<0.10	0.20	Variable	
2100 - 2200		<0.10	<0.10	290°	
2200 - 2300		<0.10	<0.10	295°	
2300 - 2400		<0.10	<0.10	280°	
July 13					
0000 - 0100		<0.10	<0.10	275°	
0100 - 0200		<0.10	<0.10	280°	
0200 - 0300		<0.10	<0.10	280°	
0300 - 0400		<0.10	<0.10	285°	
0400 - 0500		<0.10	0.20	275°	
0500 - 0600		<0.10	<0.10	260°	
0600 - 0700		0.10	0.40	255°	
0700 - 0800		0.10	0.30	260°	
0800 - 0900		<0.10	0.20	270°	
0900 - 1000		<0.10	<0.10	Variable	
1000 - 1100		<0.10	0.20	Variable	
1100 - 1200	3.	<0.10	0.20	340°	
1200 - 1300		<0.10	0.90	330°	
1300 - 1400		<0.10	0.30	335°	
1400 - 1500		<0.10	<0.10	310°	
1500 - 1600		<0.10	<0.10	320°	
1600 - 1700		<0.10	<0.10	330°	
1700 - 1800	1.	<0.10	<0.10	Variable	
1800 - 1900		<0.10	<0.10	270°	
1900 - 2000		<0.10	<0.10	235°	
2000 - 2100		<0.10	<0.10	210°	
2100 - 2200		<0.10	<0.10	200°	

Table 3 Brandon Ammonia Study #4; Brandon Manitoba
July 11 - 15, 1983.

Time (hours)	Site No.	NH ₃ conc. (ppm) 1 hr. TWA Peak		Wind Dr.	Comments
2200 - 2300		<0.10	<0.10	180	
2300 - 2400		<0.10	0.20	Variable	
July 14					
0000 - 0100		0.15	0.15	Variable	
0100 - 0200		<0.10	<0.10	070°	
0200 - 0300		<0.10	<0.10	010°	
0300 - 0400		<0.10	<0.10	025°	
0400 - 0500		<0.10	<0.10	020°	
0500 - 0600		<0.10	<0.10	040°	
0600 - 0700		<0.10	<0.10	045°	
0700 - 0800		<0.10	<0.10	065°	
0800 - 0900	4.	0.40	1.70	125°	-Sunny, clear; visible haze obscuring Simplot plant; blowing over MMU position; intermittent ammonia odour detectable
0900 - 1000		0.50	1.40	130°	
1000 - 1100		0.43	1.35	130°	
1100 - 1200		-	-	-	
1200 - 1300		-	-	-	
1300 - 1400		-	-	-	
1400 - 1500		0.42	0.70	125°	
1500 - 1600		0.58	1.45	135°	
1600 - 1700		0.90	4.05	135°	
1700 - 1800		0.71	1.00	130°	
1800 - 1900		1.30	2.40	140°	
1900 - 2000		1.18	3.25	-	
2000 - 2100		5.29	10.15	135°	-visible haze pervading entire area around MMU position; strong ammonia odour present.
2100 - 2200		7.55	11.00	140°	
2200 - 2300	5.	1.78	2.20	150°	
2300 - 2400		0.37	1.15	140°	
0000 - 0100		0.16	0.20	150°	

Table 4 Brandon Ammonia Study #4; Brandon Manitoba
July 11 - 15, 1983.

Time (hours)	Site No.	NH ₃ conc. (ppm)		Wind Dr.	Comments
		1 hr. TWA	Peak		
July 15					
0100 - 0200		<0.10	<0.10	160°	
0200 - 0300		<0.10	<0.10	175°	
0300 - 0400		0.55	1.10	150°	
0400 - 0500		0.57	1.60	145°	
0500 - 0600		0.25	0.35	150°	
0600 - 0700		0.27	0.50	155°	
0700 - 0800		<0.10	<0.10	165°	
0800 - 0900		<0.10	<0.10	170°	
0900 - 1000		<0.10	<0.10	170°	
1000 - 1100		<0.10	<0.10	180°	

RESULT SUMMARY

SITE NO.	TIMES AND DATE	NO. OF HOURS	AVG. CONC. (ppm)
1	15:00 11/7 83 - 09:00 12/7/83	18	<0.10
	14:00 12/7/83 - 11:00 13/7/83	21	<0.10
	17:00 13/7/83 - 08:00 13/7/83	15	<0.10
2	09:00 12/7/83 - 14:00 12/7/83	5	0.40
3	11:00 13/7/83 - 17:00 13/7/83	6	<0.10
4	08:00 14/7/83 - 20:00 14/7/83	12	1.57
5	20:00 14/7/83 - 11:00 15/7/83	15	0.32

Total hours of monitoring NH₃ with TGM 555 92
Total hours of downwind monitoring 47 (51.1%)

One hour Manitoba Air Quality Guideline (MAQG*)

Number of cardinal hours (downwind) when 1 hour TWA exceeded the MAQG* for ammonia in ambient air was 2 of 47 (4.3%).

Number of cardinal hours (downwind) when elevated levels of ammonia in ambient air observed (above background level of less than 0.1 ppm) was 23 of 47 (48.9%).

Observations and Discussion

Meteorological conditions were found to remain fairly constant throughout the course of this study. Atmospheric conditions remained clear during the week, with extremely warm temperatures. Winds were variable, gusting up to 35 km/hr on some occasions. No precipitation was observed. Background ammonia levels were determined to be less than 0.1 ppm, which is the detection limit of the instrument.

Some events occurred where elevated levels of ammonia were monitored in the vicinity of the Simplot plume. The first of these was recorded on July 12 (01:00-02:00, 10:00-14:00), when a visible haze was found to partially obscure the Simplot plant, and meteorological conditions caused the Simplot plume to move directly over the MMU monitoring site. While results, based upon a one hour time weighted average, were within the guideline, some instances were noted where the peak concentrations approached the 2 ppm level. During this monitoring period, an orange plume was also emitted from the Simplot operation for a period of approximately 40 minutes (11:50-12:30).

A number of events were recorded between 08:00 and 22:00 on July 14 when results were found to approach or exceed the Manitoba Ambient Air Quality Guideline (MAQG) of 2 ppm averaged over a one hour period. The most severe case occurred during the period of 18:00-20:00 when 1 hour TWA values were recorded which were two to three times the guideline level. These events were accompanied by

severe fumigation of the area surrounding the Simplot plant, with a strong odour characteristic of ammonia.

Some monitoring was performed on the periphery of one of the residential areas nearest the Simplot plant (site no. 5), immediately after the period when extreme fumigation was observed. Under these conditions, results were found to approach the 2 ppm guideline level. Based upon the observed values, as well as previous monitoring performed by the Mobile Monitoring Unit, we can conclude that, under the conditions described above, ammonia levels could exceed the guideline values within the residential areas surrounding the Brandon Industrial Park.

Simplot Chemical Company officials were contacted by personnel from the Department of the Environment, to ascertain a record of plant operations during the period covered by this study. (See Appendix 2). Based on the information provided, some process conditions existed which could have resulted in venting of ammonia, causing elevated ambient ammonia levels to be observed. Routine maintenance was performed at the nitric acid plant on July 12, with the result that other plants involved in the manufacturing of ammonium nitrate suspended operations until the nitric acid plant restarted. During the hours when high ambient levels of ammonia were observed on the evening of July 14, the ammonia plants were operating at near capacity. As the total recycle area plant was not in operation, excess ammonia being produced was transferred to low pressure storage. At the same time, ammonia was being loaded into rail cars, causing the refrigeration compressors to operate at maximum load.

Under these conditions, aggravated by the warm weather, ammonia venting could occur. However, factors other than those already reported may have a contributing effect on the observed results, as elevated levels of ammonia were observed throughout the day on July 14.

Bibliography

- 1) Bawden, G. Ambient Air Levels of Ammonia in the City of Brandon, Mobile Monitoring Unit Study M82-1, Environmental Management Division, Province of Manitoba, 1982.
- 2) Bawden, G. Ammonia Monitoring in Brandon by the Mobile Monitoring Unit, Mobile Monitoring Unit Study M82-2, Environmental Management Division, Province of Manitoba, 1982.
- 3) Szkolnicki, M. Brandon Ammonia Study No. 3, Mobile Monitoring Unit Study M83-1, Environmental Management Division, Province of Manitoba, 1983.

APPENDIX 1
BRANDON AMMONIA STUDY NO. 4
SITE DESCRIPTIONS
AND MAP OF MONITORING
LOCATIONS

Monitoring Sites

Ambient Air Monitoring for ammonia was conducted at five sites during the five days of sampling for Brandon Ammonia Study #4 (see Map #1 for approximate locations of sampling sites).

Descriptions of each site are given below.

Site No. 1

Description a) Gravel road designated 33rd Street East.

b) East north east of Simplot plant.

(Simplot bearing 250° with regard to monitoring site).

c) 1 km south of Victoria Avenue East.

d) Approximately 2 km from Simplot plant.

Site No. 2

Description a) Gravel road designated 33rd Street East.

b) North east of Simplot plant.

(Simplot bearing 215° with regard to monitoring site).

c) 0.2 km south of Victoria Avenue East.

d) Approximately 2.2 km from Simplot plant.

Site No. 3

Description a) Richmond Avenue, approximately 1.5 km east of
17th Street East.

b) South east of Simplot plant.

(Simplot bearing 325° with regard to
monitoring site).

c) Approximately 1 km from Simplot plant.

Site No. 4

Description a) 17th Street East, approximately 0.4 km south
of Van Horne Avenue.

b) West north west of Simplot.

(Simplot bearing 130° with regard to
monitoring site).

c) Approximately 0.5 km from Simplot plant.

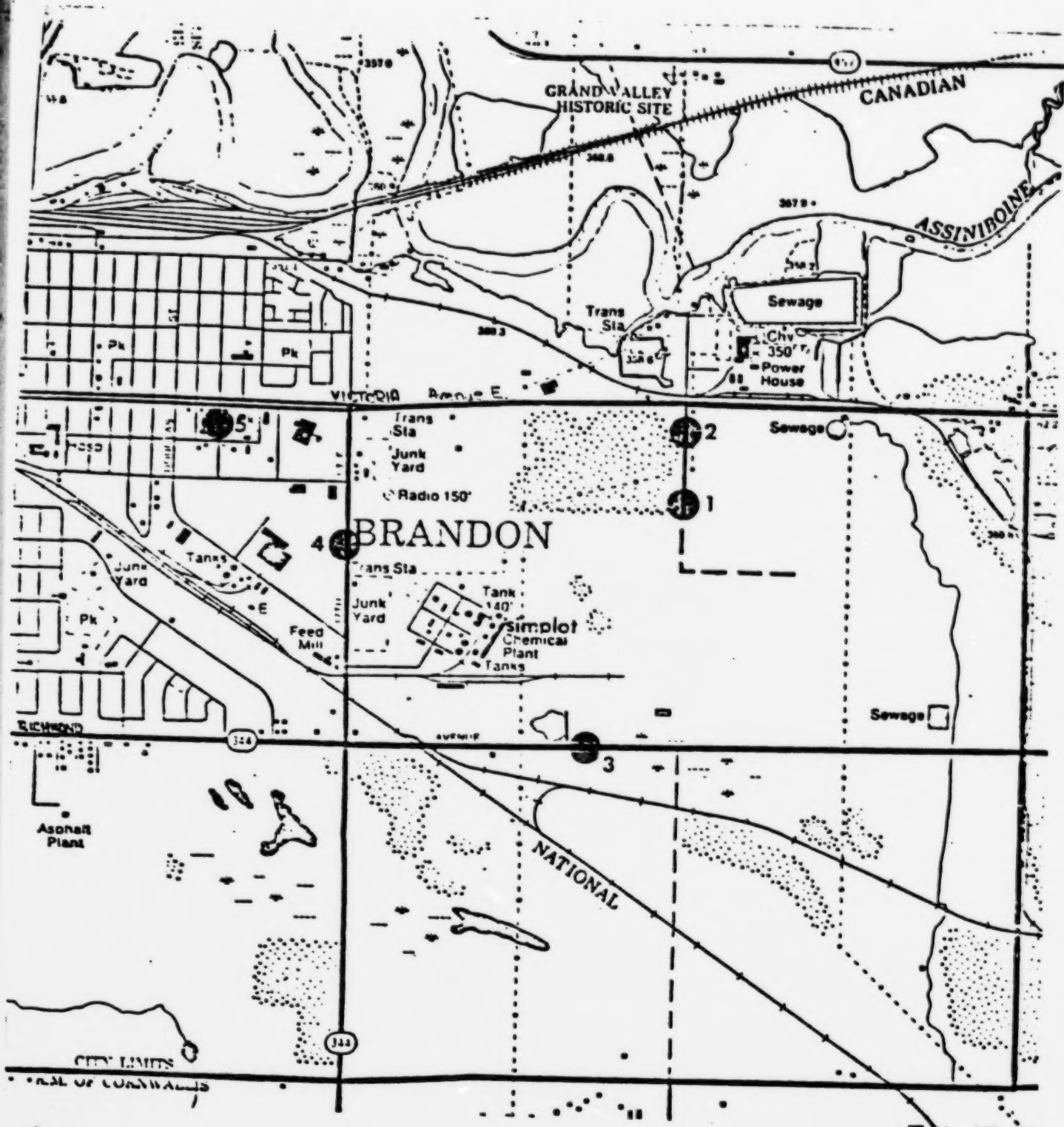
Site No. 5

Description a) 10th Street East, approximately 0.2 km south
of Victoria Avenue East.

b) North west of Simplot plant.

(Simplot bearing 135° with regard to
monitoring site).

c) Approximately 3.0 km from Simplot plant.



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MAP 1: Brandon Ambient Ammonia Monitoring Locations

● sampling sites

APPENDIX 2
SIMPLOT OPERATION RECORD
JULY 11-15, 1983

Operation Record July 11-15, 1983

(Provided by Simplot personnel)

July 11, 1983

- 1) all plants operational

July 12, 1983

- 1) total recycle urea plant shut down for maintenance all day
- 2) nitric acid plant shut down at 11:45 A.M. for routine maintenance; restarted operations at 9:30 P.M.
- 3) partial recycle urea plant shut down 4:30 P.M.; restarted 11:00 P.M.
- 4) ammonium nitrate plant shut down 4:45 P.M.; restarted 10:00 P.M.

July 13, 1983

- 1) total recycle urea plant shut down all day
- 2) ammonium nitrate prilling operation started 10:50 A.M.
- 3) venting of ammonia from high pressure valve on low pressure ammonia storage tank 7:30-8:30 A.M.; scrubber on

July 14, 1983

- 1) total recycle urea plant started 12:20 A.M.; shut down 3:10 A.M. due to breakdown
- 2) both ammonia plants, nitric acid plant, and partial recycle urea plant operating all day

- 3) ammonia being transferred to low pressure ammonia storage tank; ammonia rail car loading occurring 9:30-10:00 P.M.; truck refrigeration compressors operating at maximum
- 4) refrigeration units vented to atmosphere to remove small quantities of nitrogen, oxygen and other gas that accumulate in machines (vented gases do contain some ammonia); due to high load conditions vents were from one to two minutes in duration every 10-15 minutes
- 5) nitric acid plant evaporators blown out to remove oil, 8:15 P.M.-10:10 P.M. (once per day occurrence)

July 15, 1983

- 1) total recycle urea plant started up 3:30 P.M. at reduced capacity; shut down at 10:00 P.M. due to reactor tee plugging

*provided by Simplot personnel

POOR

QUALITY

ORIGINAL